Is intake of calcium or dairy (milk and milk products) related to adiposity in children?

Conclusion

Moderate evidence suggests that there is not a relationship between intake of calcium and/or dairy (milk and milk products) and adiposity in children and adolescents.

Grade: Moderate

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades, click here.

Evidence Summary Overview

The Dietary Guidelines Advisory Committee (DGAC) conducted a full Nutrition Evidence Library (NEL) search to evaluate the association between intake of calcium or dairy (milk and milk products) and adiposity in children. Results of this review, covering 2004-2009 were supplemented by the findings of prospective studies included in an earlier evidence review conducted by the American Dietetic Association (ADA) (1982-2004).

In combination, the two systematic literature searches included five randomized clinical trials (RCTs), 12 longitudinal studies and three review articles. Of the five RCTs, two found no association between intake of calcium or dairy and adiposity (Lappe, 2004; St Onge, 2009), two reported mixed results (DeJongh, 2006; Lorenzen, 2006) and one found evidence for a negative (protective) association between intake of calcium or dairy and adiposity (Abrams, 2007). Of the 12 longitudinal studies, six found no association between calcium or dairy and adiposity in children (Berkey, 2004; Fisher, 2004; Fiorito, 2006; Newby, 2004; Philips, 2003; Sugimori, 2004) and four found a negative (protective) association between calcium or dairy intake (Carruth, 2001; Boon, 2005; Moore, 2006; Skinner, 2003). One study reported mixed results, in that calcium or dairy intake was not associated with adiposity in hypercholesterolemic children or in non-hypercholesterolemic children ages four to six years. However, calcium intake was inversely associated with body mass index (BMI) and skinfolds among the older non-hypercholesterolemic children ages seven to 10 years (Dixon, 2005). Finally, a prospective study by Berkey et al, (2005) found a positive association between calcium intake and adiposity in children, as well as a positive association for 1% milk intake in boys and skim milk in girls.

Thus, for the 17 RCT and longitudinal studies included in the combined NEL and ADA evidence reviews, eight found no association between calcium or dairy and adiposity in children, five found an inverse (protective) effect, three found mixed results and one found a positive association. Thus, the preponderance of evidence from these studies was greatest for no association, although there was some evidence for a weak inverse (protective) association.

The NEL review also included three systematic reviews published between 2004 and 2009 that were limited to longitudinal studies and RCTs. The overall consensus of the review articles was that the preponderance of evidence did not support a protective association between intake of dairy or calcium and adiposity. Thus, although results of included studies are mixed, overall, there is insufficient evidence to suggest that intake of calcium or dairy (milk and milk products) plays a significant role in regulating adiposity in children and adolescents. Regardless of these findings, it is important to emphasize that dairy products remain rich sources of essential nutrients for children, including calcium, vitamin D, and other micronutrients for bone health and potassium for healthy blood pressure (BP).

Evidence Summary Paragraphs

Systematic Review (3)

Barr et al, 2003 (neutral quality) conducted a systematic review conducted to assess the possible impact of increased intakes of dairy products or calcium on body weight or composition. A MEDLINE search was conducted to identify randomized trials of supplementation with calcium or dairy products. Nine studies of increased dairy product intake were identified. In seven, no significant (NS) differences in the change in body weight or composition were detected between the treatment and control groups.

The interpretation of these findings was complicated by the inability to accurately determine the extent of dietary compensation for the increment in energy intake provided by the added dairy products. In 17 calcium supplemented trials that were generally three to four months in duration, only one study found greater weight loss (0.35 kg per year) in the supplemented group (1.2g calcium per day); in the remaining studies, changes in body weight or body fat were strikingly similar between groups.

Lanou and Barnard, 2008 (neutral quality) conducted a systematic review to evaluated the effect of dairy product or calcium intake on body weight and adiposity. A MEDLINE search was conducted to identify relevant studies published from 1966 to August 2007. The final sample included 49 clinical trials. Of the 49 randomized trials identified, 41 showed no effect (including all studies conducted in children), two demonstrated weight gain, one showed a lower rate of gain and five showed weight loss. The authors conclude that the majority of current evidence form clinical trials does not support the hypothesis that calcium or diary consumption aids in weight or fat loss.

Winzenberg et al, 2007 (positive quality) conducted a systematic review of RCTs examined whether calcium supplementation in healthy children affects weight or body composition. Potential studies were identified using the following electronic bibliographic databases: CENTRAL,MEDLINE, EMBASE, CINAHL, AMED, MANTIS, ISI Web of Science, Food Science and Technology Abstracts, Human Nutrition up until April 1, 2005 and hand-searched relevant conference abstracts. Studies were included if they were placebo-controlled randomized controlled trials of calcium supplementation, with at least three months of supplementation, in healthy children and with outcome measures including weight.

Meta-analyses were performed using fixed effects models and weighted mean differences for weight and height and standardized mean differences (SMDs) for body composition measures. The final sample included 17 trials. The results showed no statistically significant effects of calcium supplementation on weight (-0.14 kg; 95% CI, -0.28, -0.57kg), height (-0.22cm; 95% CI, -0.30, -0.74cm), body fat (SMD, -0.04; 95% CI, -0.08, -0.15) or lean mass (SMD, -0.14; 95% CI, -0.03, -0.31).

Randomized Controlled Trials (5)

Abrams et al, 2007 (positive quality) conducted a one-year RCT in the US to assess the effects of a prebiotic supplement and usual calcium intake on body composition changes during puberty. Subjects were randomized to receive either a daily prebiotic supplement (8 g per day) or maltodextrin (control) for one year, and were instructed to mix the supplement or placebo with calcium-fortified orange juice or milk. Body composition was measured by dual-energy x-ray absorptiometry (DEXA) at baseline and completion of study. The final sample included 97 subjects (48 prebiotic, 49 control; mean age=11 years). Results showed that subjects who received the prebiotic supplement (oligofructose and long chain inulin) had a smaller increase in BMI compared with the control group (BMI difference 0.52±0.16kg/m^2, P=0.016), BMI Z-score (difference 0.13±0.06, P=0.048) and total fat mass (difference 0.84±0.36kg, P=0.022). In considering subjects whose usual calcium intake was ≥700mg per day, those who received the prebiotic supplement had a relative change in BMI that was 0.82kg/m^2 less than control subjects (P<0.01), and BMI z-score that was 0.20 less than control subjects (P=0.003). Differences tended to be maintained one year after supplementation stopped. The authors concluded that prebiotic supplementation and avoidance of low calcium intake can have significant effects in modulating BMI and other body composition changes during puberty.

DeJongh et al, 2006 (positive quality) carried out a secondary analysis of an RCT conducted in the US to determine whether there was an association between percent body fat and calcium intake in children. Children were assigned to either a calcium supplement (1,000mg per day) or placebo for one year. Three-day diet records and 48-hour accelerometer readings were obtained at baseline, six and 12 months. Body composition was measured by DEXA at baseline and 12 months. The final sample included 178 children (mean age, four years). There were no differences in fat mass between the calcium supplemented and placebo groups. Similarly, there was no association between percent body fat and fat mass changes and dietary calcium or total calcium intake. However, among children in the lowest tertile of dietary calcium (<821mg per day), fat mass gain was lower in the calcium group (0.3±0.5 kg) than in the placebo group (0.8±1.1kg) (P=0.04) but was not correlated with mean total calcium intake (r= -0.20). The authors conclude that their results support a weak relation between changes in fat mass gain and calcium intake in preschool children, who typically consume below recommended amounts of dietary calcium.

Lappe et al, 2004 (positive quality) conducted a two-year RCT in the US to determine whterh pubertal girls assigned to calcium-rich diets or their usual calcium intakes differ in weight gain. Girls were randomly assigned to either a calcium-rich (1,500 mg calcium per day) or usual diet. The girls in the calcium-rich diet group had a mean (±SD) calcium intake of 1,656±191mg per day, whereas the girls on their usual diets averaged 961±268mg per day. Calcium intake was assessed using three-day diet diaries, height and weight were measured to calculate BMI and fat mass was determined using DEXA. The final sample included 59 girls (mean age, nine years). Although the participants in the treatment group consumed nearly twice as much dietary calcium, primarily from dairy foods, they did not have greater increases in body weight, BMI or fat or lean mass compared to the control group. These findings held when the data were grouped by tertile of calcium intake. The authors concluded that calcium-rich diets do not cause excessive weight gain in pubertal girls, but do contribute positively to overall nutrition.

Lorenzen et al, 2006 (neutral quality) conducted an RCT in Denmark to examine whther calcium supplementation affects body weight and body fat in young girls, and whether an association exists between habitual calcium intake and body weight and fat. Subjects were randomly assigned to receive a calcium supplement (500mg calcium carbonate per day) or placebo for one year. Dietary intake data was collected using a food frequency questionnaire (FFQ), height and weight were measured and DEXA was used to assess body fat. The final sample included 100 girls (mean age=13 years). A negative (protective) association was observed at baseline between higher habitual dietary calcium intake and percent body fat (r= -0.242, P=0.011). In contrast, the low-dose calcium supplement for one year had no effect on body weight, height or body fat. The authors conclude that it is possible that the effect of calcium on body weight is only exerted if it is ingested as part of a meal, or the effect may be due to other ingredients in dairy products and calcium may simply be a marker for a high dairy intake.

St Onge et al, 2009 (positive quality) conducted an RCT in the US to test whether high milk consumption leads to greater weight loss than low milk consumption during a 16-week healthy healthy diet intervention. Subjects were randomized to either high (4x236 ml servings per day) or low (1x236ml serving per day) milk consumption for 16 weeks. Children were also provided dietary counseling on healthy eating. Height and weight were measured at baseline and 16 weeks and diet was assessed using three-day diet records. The final sample included 44 children (21 in the high-milk group, 24 in the low-milk group; mean age, nine years). Results showed that overall there was no difference in any body composition measure between high- and low-milk groups during this 16-week RCT.

Cohort Studies (12)

Berkey et al, 2004 (neutral quality) analyzed prospective cohort data from the US to investigate the relationship between change in BMI and beverage consumption in adolescents. Subjects were from the Growing Up Today Study (GUTS) and were followed from baseline (nine to 14 years of age) for two one-year periods. Participants completed FFQs each year, and self-reported their height and weight. The final sample included 11,755 adolescents (5,067 boys, 6,688 girls). After adjusting for energy intake, there was no significant relationship between milk consumption and one-year weight change in boys or girls.

Berkey et al, 2005 (positive quality) analyzed prospective cohort data from the US to assess the relationship between milk, calcium, fat from foods and beverages and weight change over time. Subjects were from the Growing Up Today Study (GUTS) and were followed from baseline (nine to 14 years of age) for a period of three years. Participants completed FFQs each year and self-reported their height and weight. The final sample included 12,829 adolescents (5,550 boys, 7,279 girls). Children who drank more than three servings a day of milk gained more in BMI than those who drank smaller amounts (boys: Beta±SE, 0.076±0.038 [P=0.04] more than those who drank one to two glasses a day; girls: Beta±SE, 0.093±0.034 [P=0.007] more than those who drank zero to 0.5 glass a day). For boys, milk intake was associated with small BMI increases during the year (beta±SE, 0.019±0.009 per serving a day; P=0.03); results were similar for girls (beta±SE, 0.015±0.007 per serving a day; P=0.04). Quantities of 1% milk (boys) and skim milk (girls) were significantly associated with BMI gain, as was total dietary calcium intake. Multivariate analyses of milk, dairy fat, calcium and total energy intake suggested that energy was the most important predictor of weight gain.

Boon et al, 2005 (positive quality) conducted a longitudinal study among a cohort of children from the Netherlands to test whether dietary calcium was related to BMI in adolescents. Subjects were age 13 years at baseline in 1977 and were followed to age 36 years in 2000. Dietary intake was assessed by interview and food checklist, height and weight. Body mass index and skinfold measures were obtained at seven data points over the 23-year study duration. The final sample included 629 subjects (296 males, 333 females). For boys, a 1,000mg per day higher calcium intake was related to a 0.21 cm lower skinfold thickness (P=0.004). For girls, the highest dietary calcium intake group (>1,200mg per day) had a significantly lower skinfold thickness measurement than those consuming less than 800mg per day *P=0.04). No significant associations between calcium intake and BMI were seen.

Carruth and Skinner, 2001 (positive quality) used prospective cohort data from the US to assess the relationship between dietary intake and changes in body composition. Children's food consumption was assessed at baseline (24-60 months) and follow-up (70 months) using three dietary recalls. Height and weight were measured to calculate BMI and body composition was determined using DEXA. The final sample included 53 children (29 boys, 24 girls). Adjusting for BMI, percent body fat was significantly associated with longitudinal calcium intake ($R2=0.51$, $P<0.0001$). Higher mean longitudinal calcium and more servings per day of dairy products were associated with lower body fat.

Dixon et al, 2005 (positive quality) analyzed data from a cohort of children in the US to assess whether consumption of calcium and dairy foods are associated with measures of obesity over a one-year period. Children were from the Children's Health project, completed three 24-hour dietary recalls, had height, weight and skinfold measures taken at baseline, three, six, and 12 months. The final sample included 342 children (mean age, six years at baseline). Results showed that in all children combined, calcium intake over one-year was not associated with any measure of obesity after adjusting for age, sex, time period and energy and fat intake. In four- to 10-year-old children without hypercholesteremia, calcium intake over one year was inversely associated with sum of skinolds and trunk skinfolds ($P<0.05$). In seven- to 10 year-old children without hypercholesterolemia, calcium intake over one year was inversely associated with BMI and trunk skinfolds ($P<0.05$). The authors concluded that older children without high cholesterol may benefit most from increased calcium intake.

Fisher et al, 2004 (positive quality) analyzed data from a prospective cohort study in the US to evaluate whether calcium intake is associated with weight. Subjects were followed from age five through age nine years. Dietary intake was assessed using three 24-hour diet recalls, height and weight were measured to calculate BMI and body fat percentage was determined using DEXA. The final sample included 182 girls who were assessed at age five years and again at age nine years. There was no difference in weight between girls who met and did not meet the adequate intake level for calcium.

Moore et al, 2006 (neutral quality) analyzed prospective cohort data from the US to examine the impact of dairy intake on acquisition of body fat throughout childhood. Subjects were from the Framingham Children's Study, and were six years old at baseline and were followed into adolescence, age 13 years. Dairy intake was determined using a mean of 15 days of diet records collected before age six. Subjects were divided into tertiles of dairy intake. Height and weight were measured to determine BMI, and skinfold measurements were taken to estimate body fat. The final sample included 92 subjects (56 boys, 36 girls). Girls had a median intake of 1.09, 1.59, and 2.01 servings per day of dairy in the lowest to highest tertiles. Boys had a median intake of 1.38, 2.03 and 2.84 servings of dairy per day in the lowest to highest tertiles. After adjusting for potential confounders, children in the lowest tertile of dairy intake had the greatest gains in body fat from age five to age 13 compared to the other tertiles ($P=0.008$). However, there was no difference in BMI between the tertiles. When comparing children's change in weight and body from age 10 to age 13, children in the lowest tertile of dairy intake had significantly higher BMI ($P=0.046$) and body fat ($P=0.005$) compared to children in the other tertiles.

Newby et al, 2004 (positive quality) conducted a prospective cohort study in the US to examine the association between beverage consumption and changes in weight in preschool children. Children were participants in the North Dakota Women, Infants and Children (WIC) program, who had two visits between six and 12 months apart. The WIC staff measured height and weight, which were used to determine BMI. Dietary data were collected using a FFQ. The final sample included 1,345 subjects (mean age at baseline, three years). Results showed that change in weight was not related to milk consumption.

Philips et al, 2003 (positive quality) analyzed data from a prospective cohort study in the US to examine the relationship between dairy food intake and weight status and body fat percentage in girls. Subjects were participants in the MIT Growth and Development Study. Girls aged eight to 12 years were enrolled and followed until four-year post-menarche. At each annual visit, data were collected on percent body fat via bioelectrical impedance, BMI and dietary intake via FFQ. The final sample included 178 girls. Results show no relationship between BMI or percent body fat and dairy food or calcium consumption.

Skinner et al, 2003 (positive quality) analyzed data from a prospective cohort study in the US to determine whether dietary calcium intake is associated with body fat in children over time. Height, weight and dietary intakes (24-hour recall and two-day food records) were measured from two months through eight years, and body fat was measured at eight years using DEXA. The final sample included 52 children (25 boys, 27 girls; mean BMI at eight years=17kg/m^2). Results showed that dietary calcium was negatively associated with percent body fat (P=0.02). Longitudinal dietary calcium intake explained 4.5% to 9% of the variability in body fat in this cohort of children.

Sugimori et al, 2004 (neutral quality) analyzed data from a prospective cohort study in Japan to examine dietary factors associated with BMI. Children were from the Toyama Birth Cohort Study, which followed children born in 1989-1990 until 1996. This paper examines children from age three years to age six years. Height and weight were measured to determine BMI and a questionnaire was used to evaluate children's diet. The final sample included 8,170 children (4,176 boys, 3,994 girls). Results showed no association between consumption of milk and weight in this cohort of children.

Fiorito et al, 2006 (positive quality) conducted a cross-sectional analysis within a longitudinal cohort study from the US to determine whether dairy intake is associated with weight status. Dietary intake was assessed using three 24-hour recalls, BMI was calculated using measured height and weight and body fat was measured by DEXA. Because preliminary analyses suggested systematic underreporting of EI, the relationships among dairy servings and measures of weight status were examined for the total sample and for subsamples of under-, plausible, and over-reporters. The final sample included 172 girls (mean age=11 years). Overall only 39.5% of girls met or exceeded three servings per day of dairy intake. Girls who met the recommended three servings per day of dairy reported significantly higher energy intake and had significantly lower weight status and body fat percentage (P<0.05 for all). However, among plausible reporters, no relationship between dairy intake and weight status was noted, which may be attributable to a high percentage (45%) of overweightunder-reporters in the total sample.

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Author, Year, Study Design, Class, Rating	Participants	Methods	Outcomes
Abrams et al 2007 Study Design: Randomized Control Trial, blinded Class: A	N=97 (48 prebiotic, 49 control). Mean age: 11 years. Location: US.	Subjects were randomized to receive either a daily prebiotic supplement (8g per day) or maltodextrin (control) for one year, and were instructed to mix the supplement or placebo with calcium-fortified orange juice or milk.	Subjects who received the prebiotic supplement (oligofructose and long chain inulin) had a smaller ↑ in BMI compared with the control group (BMI difference 0.52±0.16kg/m^2, P=0.016), BMI z-score (difference 0.13±0.06

Class: A Rating:		Body composition was measured by DEXA at baseline and completion of study.	(difference 0.15±0.06, P=0.048) and total fat mass (difference 0.84±0.36kg, P=0.022). In considering subjects whose usual calcium intake was ≥700mg per day, those who received the prebiotic supplement had a relative Δ in BMI that was 0.82kg/m^2 less than control subjects (P<0.01) and BMI z-score that was 0.20 less than control subjects (P=0.003).
Barr 2003 Study Design: Systematic Review Class: M Rating:	N=9 studies using dairy products. N=17 studies using calcium supplements.	A MEDLINE search was conducted to identify randomized trials of supplementation with calcium or dairy products.	In seven out of nine dairy product studies, NS differences in the Δ in body weight or composition were detected between the treatment and control groups. The interpretation of these findings was complicated by the inability to accurately determine the extent of dietary compensation for the increment in energy intake provided by the added dairy products. In 17 calcium supplemented trials, only one study found greater weight loss (0.35kg per year) in the supplemented group (1.2g calcium per day); in the remaining studies, Δs in body weight or body fat were strikingly similar between groups.
Berkey CS, Rockett HRH et al, 2004 Study Design: Cohort study	N=11,755 adolescents (5,067 boys, 6,688 girls). Location: US.	Subjects were followed from baseline (nine to 14 years of age) for two one-year periods. Participants completed FFQs each year and self-reported their height and weight.	After adjusting for energy intake, there was NS relationship between milk consumption and one-year weight Δ in boys or girls.

(longitudinal, prospective) Class: B Rating:		height and weight.	
Berkey et al 2005 Study Design: Longitudinal Observational Study Class: B Rating:	N=12,829 (5,550 boys, 7,279 girls). Location: US.	Subjects were followed from baseline (nine to 14 years of age) for a period of three years. Participants completed FFQs each year and self-reported their height and weight.	Children who drank more than three servings a day of milk gained more in BMI than those who drank smaller amounts (boys: Beta±SE, 0.076±0.038 [P=0.04] more than those who drank one to two glasses a day; girls: Beta±SE, 0.093±0.034 [P=0.007] more than those who drank zero to 0.5 glass a day). For boys, milk intake was associated with small BMI ↑ during the year (beta±SE, 0.019±0.009 per serving a day; P=0.03); results were similar for girls (beta±SE, 0.015±0.007 per serving a day; P=0.04).
Boon et al 2005 Study Design: Prospective cohort study Class: B Rating:	N=629 (296 males, 333 females). Location: The Netherlands.	Subjects were age 13 years at baseline in 1977 and were followed to age 36 years in 2000. Dietary intake was assessed by interview and food checklist, height and weight. BMI and skinfold measures were obtained at seven data points over the 23-year study duration.	For boys, a 1,000mg per day higher calcium intake was related to a 0.21cm lower skinfold thickness (P=0.004). For girls, the highest dietary calcium intake group (>1,200mg per day) had a significantly lower skinfold thickness measurement than those consuming less than 800mg per day *P=0.04). NS associations between calcium intake and BMI were seen.

Carruth BR, Skinner JD 2001 Study Design: Cohort Study Class: B Rating:	N=53 (29 boys, 24 girls). Location: US.	Children's food consumption was assessed at baseline (24-60 months) and follow-up (70 months) using three dietary recalls. Height and weight were measured to calculate BMI and body composition was determined using DEXA.	Adjusting for BMI, percent body fat was significantly associated with longitudinal calcium intake (R2=0.51, P<0.0001). Higher mean longitudinal calcium and more servings per day of dairy products were associated with lower body fat.
DeJongh, Binkley and Specker 2006 Study Design: randomized controlled trial Class: A Rating:	N=178. Mean age: Four years. Location: US.	Children were assigned to either a calcium supplement (1,000mg per day) or placebo for one year. Three-day diet records and 48-hour accelerometer readings were obtained at baseline, at six and 12 months. Body composition was measured by DEXA at baseline and 12 months.	There were no differences in fat mass between the calcium supplemented and placebo groups. Similarly, there was no association between percent body fat and fat mass Δs and dietary calcium or total calcium intake. However, among children in the lowest tertile of dietary calcium (<821mg per day), fat mass gain was ↓ in the calcium group (0.3±0.5kg) than in the placebo group (0.8±1.1kg) (P=0.04), but was not correlated with mean total calcium intake (r= -0.20).
Dixon et al 2005 Study Design: Prospective cohort study Class: B Rating:	N=342. Mean age: Six years at baseline. Location: US.	Children completed three 24-hour dietary recalls and had height, weight and skinfold measures taken at baseline, three, six and 12 months.	Results showed that in all children combined, calcium intake over one year was not associated with any measure of obesity after adjusting for age, sex, time period, energy and fat intake. In four- to 10-year-old children without hypercholesteremia, calcium intake over one year was inversely associated with sum of skinfolds and trunk skinfolds (P<0.05).

			In seven- to 10- year-old children without hypercholesterolemia, calcium intake over one year was inversely associated with BMI and trunk skinfolds ($P<0.05$).
Fiorito et al 2006 Study Design: Cross-sectional study Class: D Rating:	N=172 girls. Mean age: 11 years. Location: US.	Dietary intake was assessed using three 24-hour recalls, BMI was calculated using measured height and weight, and body fat was measured by DEXA. Because preliminary analyses suggested systematic underreporting of EI, the relationships among dairy servings and measures of weight status were examined for the total sample and for sub-samples of under-, plausible and over-reporters.	Girls who met the recommended three servings per day of dairy, reported significantly ↑ energy intake and had significantly ↓ weight status and body fat percentage ($P<0.05$ for all) compared to girls who consumed less dairy. However, among plausible reporters, no relationship between dairy intake and weight status was noted, which may be attributable to a ↑ percent (45%) of overweight under-reporters in the total sample.
Fisher JO, Mitchell DC et al 2004 Study Design: Cohort study (longitudinal, prospective) Class: B Rating:	N=182 girls who were assessed at age five years and again at age nine years. Location: US.	Subjects were followed from age five through age nine years. Dietary intake was assessed using three 24-hour diet recalls, height and weight were measured to calculate BMI, and body fat percentage was determined using DEXA.	There was no difference in weight between girls who met and did not meet the adequate intake level for calcium.
Lanou AJ and Barnard ND, 2008 Study Design: Meta-analysis	N=49 clinical trials.	A MEDLINE search was conducted to identify relevant studies published from 1966 to August 2007. The final sample included 49	Of the 49 randomized trials identified, 41 showed no effect (including all studies conducted in children), two demonstrated weight gain, one showed a ↓ rate of gain

or Systematic Review Class: M Rating:		clinical trials.	and five showed weight loss.
Lappe et al 2004 Study Design: randomized controlled trial Class: A Rating:	N=59. Mean age: Nine years. Location: US.	For two years, girls were randomly assigned to either a calcium-rich (1,500mg Ca per day) or usual diet. The girls in the calcium-rich diet group had a mean (±SD) calcium intake of 1,656±191mg per day, whereas the girls on their usual diets averaged 961±268mg per day. Calcium intake was assessed using three-day diet diaries, height and weight were measured to calculate BMI, and fat mass was determined using DEXA.	Although the participants in the treatment group consumed nearly twice as much dietary calcium, primarily from dairy foods, they did not have greater ↑ in body weight, BMI or fat or lean mass compared to the control group. These findings held when the data were grouped by tertile of calcium intake.
Lorenzen et al 2006 Study Design: Randomized double-blind placebo controlled trial Class: A Rating:	N=100 girls. Mean age: 13 years. Location: Denmark.	Subjects were randomly assigned to receive a calcium supplement (500mg calcium carbonate per day) or placebo for one year. Dietary intake data was collected using an FFQ, height and weight were measured, and DEXA was used to assess body fat.	A negative (protective) association was observed at baseline between higher habitual dietary calcium intake and percent body fat (r= -0.242, P=0.011). In contrast, the low-dose calcium supplement for one year had no effect on body weight, height or body fat.
Moore et al 2006 Study Design: Prospective Cohort Study Class: B	N=92 (56 boys, 36 girls). Location: US.	Subjects were six years old at baseline and were followed into adolescence, age 13 years. Dairy intake was determined using a mean of 15 days of diet records collected before age six. Subjects were divided into	Girls had a median intake of 1.09, 1.59 and 2.01 servings per day of dairy in the lowest to highest tertiles. Boys had a median intake of 1.38, 2.03 and 2.84 servings of dairy per day in the lowest to highest tertiles.

Rating:		tertiles of dairy intake. Height and weight were measured to determine BMI, and skinfold measurements were taken to estimate body fat.	After adjusting for potential confounders, children in the lowest tertile of dairy intake had the greatest gains in body fat from age five to age 13 compared to the other tertiles (P=0.008). However, there was no difference in BMI between the tertiles. When comparing children's Δ in weight and body from age 10 to age 13 years, children in the lowest tertile of dairy intake had significantly ↑ BMI (P=0.046) and body fat (P=0.005), compared to children in the other tertiles.
Newby PK, Peterson KE et al, 2004 Study Design: Cohort study (longitudinal, retrospective) Class: B Rating:	N=1,345. Mean age at baseline: Three years. Location: US.	Children were participants in the North Dakota WIC program, who had two visits between six and 12 months apart. WIC staff measured height and weight, which were used to determine BMI. Dietary data were collected using a FFQ.	Results showed that Δ in weight was not related to milk consumption.
Phillips SM, Bandini LG et al 2003 Study Design: Cohort study (longitudinal, prospective) Class: B Rating:	N=178. Location: US.	Girls aged eight to 12 years were enrolled and followed until four year post-menarche. At each annual visit, data were collected on percent body fat via bioelectrical impedance, BMI and dietary intake via FFQ.	Results show no relationship between BMI or percent body fat and dairy food or calcium consumption.

Skinner JD, Bounds W et al 2003 Study Design: Cohort study (longitudinal, prospective) Class: B Rating:	N=52 (25 boys, 27 girls) Mean BMI at eight years: 17kg/m^2. Location: US.	Height, weight, and dietary intakes (24-hour recall and two-day food records) were measured from two months through eight years, and body fat was measured at eight years using DEXA	Results showed that dietary calcium was negatively associated with percent body fat (P=0.02). Longitudinal dietary calcium intake explained 4.5% to 9% of the variability in body fat in this cohort of children.
St. Onge et al 2009 Study Design: Randomized controlled trial Class: A Rating:	N=44 (21 in the high-milk group, 24 in the low-milk group. Mean age: Nine years. Location: US.	Subjects were randomized to either high (4x236ml servings per day) or low (1x236ml servings per day) milk consumption for 16 weeks. Children were also provided dietary counseling on healthy eating. Height and weight were measured at baseline and 16 weeks, and diet was assessed using three-day diet records.	Results showed that overall there was no difference in any body composition measure between high- and low-milk groups during this 16-week RCT.
Sugimori H, Yoshida K et al 2004 Study Design: Cohort (longitudinal, prospective) Class: B Rating:	N=8,170 (4,176 boys, 3,994 girls). Location: Japan.	Children who were born in 1989-1990 at birth and followed until 1996. This paper examines children from age three years to age six years. Height and weight were measured to determine BMI and a questionnaire was used to evaluate children's diet.	Results showed no association between consumption of milk and weight in this cohort of children.
Winzenberg T, Shaw K et al, 2007 Study Design: Meta-analysis	N=17 trials.	CENTRAL,MEDLINE, EMBASE, CINAHL, AMED, MANTIS, ISI Web of Science, Food Science and Technology Abstracts, and Human Nutrition were search up to April 1, 2005	The results showed no statistically significant effects of calcium supplementation on weight [-0.14kg; 95% CI, -0.28, -0.57kg], height (-0.22cm; 95% CI, -0.30,

or Systematic Review Class: M Rating:		to identify studies that were placebo-controlled RCTs of calcium supplementation, with at least three months of supplementation, in healthy children and with outcome measures including weight. Meta-analyses were performed using fixed effects models and weighted mean differences for weight and height and standardized mean differences (SMDs) for body composition measures.	-0.74cm), body fat (SMD, -0.04; 95% CI, -0.08, -0.15) or lean mass (SMD, -0.14; 95% CI, -0.03, -0.31).

Research Design and Implementation Rating Summary
For a summary of the Research Design and Implementation Rating results, click here.

Worksheets

Abrams, Steven A et al Effect of Prebiotic Supplementation and Calcium Intake on Body Mass Index, J Pediatr 2007;151:293-8

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